DESIGNING FOR TECHNOLOGY ENABLED REFLECTIVE PRACTICE: TEACHERS' VOICES ON PARTICIPATING IN A CONNECTED LEARNING PRACTICE.

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Abstract

Approximately 2000 secondary school teachers, many for the first time, experienced participating in a technology-enabled, practice-based, blended learning teacher professional development programme. A majority of the teachers work in schools situated in rural and remote locations, teaching students from socio-economically marginalised backgrounds. Thus far, the programme has enabled university-school linkages through the formation of teacher communities of practice and through certification courses. This chapter explores the teacher's voices, experiences and changes in beliefs and practices through participating in the continuous professional development programme implemented at scale in the Indian context to evaluate the processes and argues that the integration of academic, administrative and policy goals at every level of the intervention is vital for sustaining teacher professional development quality at scale.

INTRODUCTION

This chapter discusses teachers' articulation of their attitudes, knowledge and perceptions concerning participating in a continuous professional development [CPD] programme for upper primary and secondary school teachers across four states in India. It traces the changes in the teachers' beliefs and practices as a result of participating in a technology-enabled, practice-based, blended learning certificate CPD programme implemented at scale in the Indian context. The aim and purpose of doing such an exercise were to study how the CPD framework operates on the field, and the focus of this research study is, therefore, on the evaluation of the processes of the CPD programme.

The nature of teacher professionalism and the role of the school teacher in contemporary India has changed to some extent due to the Right to Education [RTE]) Act (GoI 2009) which makes school

education a fundamental right for all. Accountability of teacher's work has become the focus of the discourse on quality education and student learning outcomes by politicians and policymakers alike (Sarangapani et al., 2018; Batra 2012; Day & Sachs, 2004). Hence, implementing a CPD framework for teachers involves understanding the intersections between macro characteristics of the professional development of teachers and the microcosms in which the teachers operate. The macro aspects include policies, structures, status and expectation of teachers from the state education system and vice-versa. The micro aspects involve contextualising teacher education pedagogy. The integration of ICT for delivery of CPD programmes requires new imagination of macro-level structures as well as pedagogies and learning environments. Keeping the complexity of implementing a CPD programme at scale in a diverse context such as India in focus, this study aims to answer how the programme's CPD framework operates on the field and what are its highlights and challenges. The study is presented from the vantage point of teachers who are the primary recipients and stakeholders of this programme.

This chapter, first presents the design, approach and implementation of the CPD programme to provide the readers with a context. Subsequently, it develops an understanding of Indian teachers as professionals and the evolution of professional learning communities by presenting the teachers' landscape and the viewpoints of those participating in the CPD. It delineates the need for a CPD programme to be responsive to the learners' contexts and lays out the ground as to why there must be a systemic intervention at both the policy and administrative levels to enable CPD. It is envisaged that the learnings from this research will inform CPD policy and processes required for large-scale pedagogical transformation in India, as well as in the broader South Asian context.

RESEARCH METHODS

Any CPD programme requires considering multiple stakeholders with differing needs, especially one implemented at scale across the diverse contexts seen in four Indian states. Evaluation of such a programme can lead to improvements in design and enhance outcomes. This study uses qualitative methods to understand how a CPD programme implemented at scale operates on the field from the viewpoint of teachers. A qualitative method enables nuanced understanding of differing levels and nature of adoption and changes through detailed descriptive explanation, mix of quantitative and qualitative data, formal and informal methods of data collection, face-to-face interactions, field observations and online data (Patton, 1990).

This study depicts a realistic picture of a complex interconnected CPD framework to enable formulation of the programme's theory-of-action by establishing connections between the implementation processes and the expected programme outcomes (Pattson, 1990, p 107). The specific research questions are (1) how does the CPD framework operate on the field, from the viewpoint of teachers? and (2) what are the highlights and challenges of implementing the

programme? Quantitative and qualitative data were gathered from four primary sources that included responses from online feedback post workshops, communities of practice posts, field visit reports on implementation in schools and telephonic interview of a representative, purposive sample of teachers from each subject. A detailed analysis is presented in the section titled Teacher's Voices.

PROGRAMME DESIGN & APPROACH

The latest National Curriculum Framework for Teacher Education [NCFTE 2009] (NCTE, 2009), drawing on the national curriculum for elementary and secondary education, National Curriculum Framework 2005 [NCF 2005] (NCERT, 2005), advocates for the development of reflective and constructivist practitioners. Based on the shifts, from a predominantly positivist epistemology of practice to a constructivist position (NCERT, 2005; NCTE 2009), there is a dire need for quality CPD to reach and support teachers to realise the intended reforms in classrooms and aid their professional growth. The discourse on teacher accountability has become inevitable, however, it has to shift from *contractual accountability* that relies on measuring teachers against standards to *responsive accountability* aimed at developing teachers as reflective autonomous professionals through a collaborative process and relies on self-regulation to address accountability issues (Sachs, 2016). Deriving from this, a CPD framework was designed to develop teachers as constructivist and reflective practitioners (Schön, 1983; 1987). The CPD design includes developing teachers Pedagogical Content Knowledge [PCK] (Shulman, 1986) adopting a practice-based pedagogy (Korthagen & Kessels, 1999; Ball & Cohen, 1999) using exemplar OER; a blended approach of workshops and online MOOC based courses and creating an online teachers' communities of practice (Wenger, 1998) to enable professional discourse among teachers by making classroom practice public (Sarangapani, 2011) to support teachers' pedagogical transformation process in the classrooms and collaboratively build a discourse around teachers' practice to create a self-regulating environment. This CPD framework has been developed and implemented at scale in a phased manner since 2016, covering over 2000 teachers across four states in India.

A key aspect of the CPD framework design to develop teachers as reflective practitioners involves creating a connected learning experience for teachers. The CPD framework for secondary school teachers was designed, developed and implemented through the Connected Learning Initiative (CLIx)[1]. CLIx aims to improve the education of high school students in English, mathematics and science leveraging technological innovations. The intervention has developed ICT-based student resources and professional development programme for teachers. This section outlines the theoretical and conceptual underpinnings that informed the design of the complex CPD framework

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[1] . For more detailed information about CLIx, please visit https://clix.tiss.edu/

that connects multiple conceptual constituents aiming at pedagogical transformation of teachers as well as improving student learning outcomes.

DESIGN

Connecting subject content and pedagogy - **Pedagogical courses in English language learning, Mathematics and Science:** The design principle draws on ideas of student learning from the NCF 2005 which espouses a constructivist and active approach to teaching and learning, adopting a theoretical orientation of social reconstructionism. Curricular content is defined as integrating the domain knowledge with the learners' sociocultural contexts. The learning of subject matter is conceived as a series of activities facilitated via rich pedagogical interactions that learners engage in to construct their knowledge of the domain bringing their prior knowledge and experiences into the process. Another aspect of deep learning is best outlined in Lee Shulman's (2004) work on teacher knowledge and practice supporting active learning pedagogies. Explaining, representing, creating examples, understanding students misconceptions and incorporating the culture, language and context of the students is an important aspect of knowledge-base that a teacher needs to build. This knowledge was conceptualised by Lee Shulman (2004) as PCK. When teachers are exposed to the domains of knowledge in a historical and contextualised way, it not only helps them develop content but also enables development of subject specific pedagogy. PCK is developed and influenced by the teachers' subject knowledge, everyday activities, availability and use of resources, personal beliefs, beliefs about the subject and learners and is rooted in the experience and contexts of the learners and their communities. Part of this connect to the learner's current schema is language. The linguistic situation in India is complex wherein multiple languages - home language/s, regional language/s and English - form a complex matrix in a student's school life. The NCF 2005 encourages a multilingual approach to teaching and learning. Based on these guiding principles, the *Reflective Teaching with ICT* [RTICT] certification programme, available in English and Hindi, was developed. It uses the CLIx student modules[2] available in English, Hindi and Telugu as Open Educational Resources [OERs] exemplar. Together with the pedagogic courses aimed at enabling teachers to integrate technology meaningfully using the student modules to support active learning, the communities of practice too were designed to nurture the development of the teachers' PCK. Thus, a three-pronged approach of using communities of practice, pedagogic courses for teachers and reflection on implementation of student modules was used to ensure CPD.

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[2] Fourteen modules have been developed in communicative English, mathematics and science for secondary school students as Open Educational Resources. The modules are 1) Digital Literacy - Invitation to CLIx 2) English Beginner 3) English Elementary 4) Geometric Reasoning - Part I 5) Geometric Reasoning Part II 6) Proportional Reasoning 7) Linear Equations 8) Atomic Structure 9) Basic Astronomy 10) Ecosystem 11) Health and Disease 12) Sound 13) Understanding Motion 14) Reflecting on Values. Each of the modules are divided into units and further divided into lessons. The lessons have a variety of activities for students that are classroom , technology-enabled and hands-on with different levels of facilitation required by teachers. The modules are accessed in schools via the CLIx learning platform specifically designed to work offline and providing a connected learning experience through local area network.

Connecting teachers with teachers, teacher educators and subject experts- Nurturing subject-based teacher communities of practice: To enable the development of a practice-based epistemology in education there is a need to create a professional discourse among teachers. A community of practice (Wenger, 1998) is an epistemic community that draws on the idea of situated learning theory. Lave and Wenger (1991) developed the idea of situated learning (or situated social practice), describing learning as occurring through participation in social processes situated within specific sociocultural contexts that shape the learning through participation in its activities. As argued by Wenger (1998), the practice is itself the curriculum. Learning or meaning-making takes place through the dual actions of engaging in community activities, discussions, conversations, and reflections and sharing artefacts such as teaching resources, methods, and documents. The artefacts produced through participation in the community is the knowledge of practice produced by the community. Learning is most effective when a practitioner actively participates, produces artefacts, and engages in discussions about the practice (Thirumalai, 2017). . The university faculty act as brokers (Wenger, 1998), connecting teachers' communities of practice with other communities such as teacher educators' and education administrators', thereby bring new meaning into each of these communities were designed to connect the teachers of a subject with each other, with the teacher educators, and with the administrators. These focused on fostering domain based group communication to encourage nuanced discussions about the practice.

Connecting practice with theory through practice-based pedagogic courses and Community of Practices: Traditional teacher education models have been developed to integrate theory by applying technical designs such as lesson plans and activities converted by experts into implementable procedures, to practical classroom situations. However, such an approach is prescriptive and creates a theory-practice gap that teacher education has been perpetually struggling with (Korthagen & Kessels, 1999). Building on this argument, Korthagen & Kessels (1999) suggest a realistic approach to teacher education where a teacher's learning process involves developing theory from practice, considering the relationship between teacher cognition and teacher behaviour. They use a model of levels of learning based on the psychological idea of *gestalt* whereby individuals respond to a situation through the formation of a holistic perceptual identity of a situation. There are three learning levels in this model, the gestalt level, the schema level and the theory level. In the gestalt level, teachers reflect on their *gestalt*, examining their behaviour, beliefs, and theories of learning of specific teaching situations. This enables teachers to start developing a *schema,* moving slightly away from the specific situation to analyse and reflect on the situation in more general terms making use of theoretical knowledge (*episteme*) and progressing to the theory level, where teachers can reflect on the situation in more general terms, connecting their experiences to construct logical relationships and meanings that may apply to many such situations, thus engaging in the development of theory. This learning is a cyclic process with learning in the theory level becoming intuitive and subconscious in the teachers' action leading to the refinement of teacher's gestalts, termed as *level reduction*. This three-level learning

model integrates Lave and Wenger's (1991) situated social learning perspective, where all knowledge is grounded in a social context and where the learner can build theory by logically ordering the schema level experiences that are rooted in practical situations. Such a conceptualisation requires a practice-based pedagogy of teacher education (Korthagen, 2010). A practice-based learning approach requires teachers to inquire into their classroom teaching, interpret theoretical ideas by connecting their practice to the ideas rather than using it to prepare for their teaching. Teachers may also engage with artefacts of teaching situations such as videos, student's work and so on, analyse these artefacts and gain insights on how to adapt the learnings into their practice. Engaging in discussions collectively in a community of practice enriches the discussions and as more ideas and challenges may be deliberated on, creating an environment of professional collegiality and enabling development of a professional discourse around teaching practice (Ball & Cohen, 1999), essentially developing as reflective practitioners. In general, reflective teaching aims at developing critical inquiry into one's practice. It was first identified by John Dewey (1938) as a form of thinking that was different from routine action. Later, (Schön, 1983, 1987) developed the idea of a reflective practitioner and its development. Schön also identified two types of reflection, *reflection-on-action*, thinking about the experience after the event is over and *reflection-in-action*, thinking while doing. Essentially implying, like Dewey, that professional practice is never routine and involves responding to situations based on experience and practical wisdom. Teacher professional knowledge is an amalgamation of theoretical or formal knowledge, tacit craft knowledge embedded in experience and knowledge that is generated by inquiring into one's own practice (Winch, 2004; Cochran-Smith & Lytle , 1999). To build such a knowledge-base teachers fundamentally need to develop as reflective practitioners. Developing as a reflective practitioner is also known to be more effective when one is engaged in collective dialogue with peers. From this standpoint, the pedagogic courses focus not just on sharing theory with the teachers, but also on ensuring that these learning activities are designed to foster active discussions in the communities of practice connecting theory to examples that the teachers can share based on their own experience

Connecting students with peers and teachers: The third of the three-pronged design of the framework is the CLIx student modules. The design of all CLIx educational resources is informed by a pedagogic framework referred to as the 'Pedagogic Pillars' to support an interactive and learner-centered learning environment. The three pillars are peer learning or collaboration, risk-taking and learning from mistakes and relevance and authenticity of learning. The first pillar, peer learning encourages dialogue between student-student and student-teacher to integrate ideas, co-construct knowledge to deepen learning of concepts through collaboration. The second pillar encourages teachers to create a classroom environment in which risk-taking and learning from failure are integral to the educational process creating a culture that deepens the connection between students and teachers. The third pillar is intended to develop a culture in which students understand that their learning is meaningful for their lives and the teaching pedagogies support learning that is true to the domain knowledge of the subject being taught as well as relevant to the students' context (CLIx, 2017). The implementation of these modules in their classrooms enabled teachers to reflect on their practices and themselves construct the knowledge the pedagogic courses

facilitated the learning of and then share their ideas in the communities of practice to further their PCK.

APPROACH

The foundational enabling conditions for integrating ICT into teacher professional development are access to devices and the internet, relevance to school curricula and practice and teacher's availability of time for professional development (Albion, Forkosh-Baruch & Peeraer, 2015). The CLIx baseline data (Chandran & Roy, 2017) revealed that the majority of the teachers accessed the internet and computing tools through mobile smartphone devices. Data also revealed that over 50% percent of teachers needed training to become digitally literate, making the option of implementing a purely online professional development course improbable in these circumstances. Taking into consideration the context of CPD and the Indian school teacher's personal and systemic conditions CLIx has adopted the following approach (See Table 11.1).

Teacher professional development is being offered as a two-year, university-based 17-credit postgraduate certificate programme RTICT (See Fig.11.1) by the Tata Institute of Social Sciences (TISS) for long-term sustainability. The programme includes two foundation courses to develop abilities to use ICT in education (04 credit course), enhance action research skills and develop PCK in any one pedagogical course (04 credit course) in communicative English language, mathematics or science teaching. In addition, several interdisciplinary electives (2 credit courses), such as ones on values or toy-making, have been developed so that teachers can choose any three. RTICT is offered as a blended model, where teachers meet for three days face-to-face in a workshop mode to experience hands-on the ICT-based resources and platforms used by the courses including the CLIx modules. The courses adopt practice-based pedagogy whereby teachers implement OERs that exemplify research-based pedagogies and best practices. Additionally teachers are expected to reflect and report on their experiences of implementing these modules. The CLIx field team provides technical support and monitors the implementation by visiting schools on a periodic basis. Furthermore, teachers continue their learning process by completing the courses on the *TISSx* platform. The widespread use of smartphones to access the internet prompted the use of an open source mobile messaging application for creating subject-based teacher communities of practice. The pedagogy framework consisting of the three pedagogic pillars mentioned above are integrated into all educational resources and facilitation processes developed and offered by CLIx and are woven into the theoretical components of the pedagogic courses.

IMPLEMENTATION

The CPD programme in CLIx was offered (See Table 11.2) from 2016-2017 in four states[3] in India. In the first year, only the face-to-face workshop sessions were implemented with teachers to introduce the student modules and prepare them to implement the modules in their schools. Teachers participated in subject-based community of practice groups created on the mobile messaging application. The implementation was preceded by intense field work and negotiations with the state education department and readying the school computer labs. Approximately 86%, 32% and 27% of schools implemented[4] the digital literacy, English and mathematics student modules respectively in three of the four states. In 2017-2018 the RTICT was launched in all four states offering four[5] courses. Participating teachers had to mandatorily register into the programme and enrol in two courses. The implementation design also included building capacity of local teacher educators (TEs) to strengthen the scaling process. Approximately 1600 teachers from the four states enrolled in the courses, teachers connected with the course faculty and actively participated in the communities of practice. However, less than two per cent of the teachers engaged in online learning (CLIx, 2017).

TEACHERS' VOICES

As the teachers journeyed through the CPD programme during the academic year 2017-18, their experiences were actively sought and recorded. Online feedback forms at the end of the workshops supplemented by the observation reports filled by CLIx team members collated the first impressions the teachers had of the programme. The communities of practice posts presented the ongoing journey of growth and the subtler nuances of the usefulness of the programme as perceived by the teachers. The field visit reports on implementation in schools added depth to the documentation of teachers' experiences evolving over the course. Finally, at the end of the course, a representative, purposive sample of teachers from each subject was interviewed telephonically to understand their experience of having participated in the CPD programme. These four primary sources of data lent themselves to detailed qualitative analyses that are expounded upon in this section to enable comparison between the espoused CPD framework and the actual implementation to answer the research questions.

2017-18 Workshop Feedback

Taking into consideration micro aspects of CPD as well as macro systemic aspects, the feedback, stories and experiences of teachers during the workshops have been thematically classified into

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[3] The CLIx programme is being implemented in four Indian states namely, Chhattisgarh (CG), Mizoram (MZ), Rajasthan (RJ) and Telangana (TS).

[4] Typically, teachers implemented 2 or 3 lessons in the first unit of the digital literacy, English and mathematics CLIx student modules.

[5] C01 – Introduction to ICT in Education; S01 – Communicative English Language Teaching; S02 – Reflective Mathematics Teaching; S03 – Interactive Science Teaching.

four[6] categories: content, pedagogy, implementation/technology and systemic/career,. Teachers' confidence levels responses were collected at the end of the workshop using a 5-point Likert scale. The qualitative responses were analysed from the following three open-ended questions asked in the workshop feedback: (1) Any other comments? (2) What did you like most about this workshop? (3) What did you like least about this workshop? These responses were further categorised into the four themes mentioned above. The digital literacy workshops for the foundation course were conducted at the school cluster level by local resource persons trained by university faculty for some districts of Rajasthan and all districts of Telangana, however, the subject based course workshops were facilitated directly by the module and course designers and university faculty. This subsection elaborates on the four categories identified above.

Content
Teachers indicated they were mostly satisfied with the workshop content. As there were very few teachers who engaged with the online course, the teacher's opinions on the content of the complete course were not possible to determine for the academic year 2017-18. The qualitative feedback was also positive, and teachers expressed that they found the content covered in the workshop useful for their professional development in all three subjects (See Fig. 11.2).

In all the states, most teachers (except mathematics) initially struggled to find relevance to their professional development with the digital literacy activities. The digital literacy activities included learning to use tools such as mind maps, spreadsheets, vector drawing and dynamic geometry. Teachers engaged more easily with subject content, solving puzzles and questions posed in science and mathematics and less with PCK. The topics developed into mathematics and science CLIx student modules were meant to serve as exemplars for demonstrating meaningful use of technology supporting active and interactive pedagogies and discovering research-based PCK. Similarly, the English student modules did not focus on the textbook curriculum and instead addressed listening and speaking skills. However, the teachers, expecting complete coverage of curricular content, were disappointed. Several teachers informally expressed that the student modules were more suitable for lower grade students rather than the 9th grade students with whom they were to implement the modules.

Paradoxically, responding to the questions of what they liked and disliked about the workshop concerning content, most teachers focused on the usefulness of their favourite CLIx module or ICT tool. In most of the workshops, teachers were keen to spend maximum time practising on the computers and were not interested in participating in theory-based sessions.

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[6] Content - comments related to workshop session content and the CLIx student modules
Pedagogy - comments related to workshop facilitation and duration , CLIx pedagogic pillars
Implementation/technology - comments related to implementation, infrastructure, technology issues experienced in the workshop
Systemic/career - comments related to administrative , career and systemic issues raised by teachers.

Pedagogy

The majority of the teachers appreciated that the faculty adopted an active and interactive pedagogy, allowing teachers to freely express their opinions, discuss their experiences and the collaborative learning environment of the workshops as expressed in the open ended responses by teachers in the post workshop feedback. Specifically, the science teachers appreciated the hands-on experiments that were covered in the workshops; the English teachers appreciated the collaborative environment and the mathematics teachers, the independence to explore the GeoGebra tool and engage in mathematics processes of reasoning and problem-solving. All teachers, however, felt that the workshop time was insufficient for hands-on use with computers. The lack of time was especially highlighted by many of the teachers working in rural contexts who had not used computers before these workshops. The reported confidence levels in integrating ICT in teaching were different in the four states, however, none were lower than 60%. Furthermore, most teachers were confident at the end of the workshops that they would be able to help their students learn from their mistakes. The practice-based component of the professional development was significantly new for teachers. During the discussions around the implementation of the CLIx student modules in their schools in the workshops, teachers were mostly sceptical about following through with the plan. Most teachers expressed that the school computer labs were not functioning and they did not have the ability to make it functional. Issues about timetabling the activity was also a significant concern as teachers expressed that they were under time pressure to complete the prescribed syllabus.

Implementation, Infrastructure & Technology

In a majority of the workshops, except in Jaipur, Rajasthan the state department's computer labs were used to conduct the workshops. Despite the technical team's effort to set up the technology before the workshops, the teachers faced many technology and infrastructure issues. Often the size of the computer labs was small with insufficient working computers that led to teachers sharing computers or working in cramped spaces. Unscheduled power outages disrupted the training several times. In many cases, even if the computer was working the mouse would not work correctly. The internet connection, when the training were conducted in districts away from the capital city, was poor. All this added significantly to both the faculty as well as teachers' frustrations. Additionally, although the proposed workshop timings were from 10:00 am to 5:00 pm, most teachers would arrive late on the first day of the workshop and request to leave early, especially on the last day. Sometimes teachers did not receive the order to attend the workshop on time; other times teachers had to travel long distances from surrounding districts to attend the workshop.

While in the pedagogy section, the teachers' ease with using technology seemed low based on their feedback that they would have liked more time for computer-based activities, all teachers reported increased confidence in their ability to handle computers. The open response feedback varied

based on the number of technical glitches that affected the trainings. The smoother the training itself went, the higher the confidence reported with respect to CLIx adoption and the fewer the complaints linked to dearth of infrastructure in their schools.

Systemic

Teachers are mandated by the state education departments to participate in the professional development programme, hence in every workshop, a few teachers were disinterested in the programme. The senior teachers in all states who had less than two years of service left were not interested in engaging in new pedagogies. Many such teachers felt that they had taught successfully without using ICT and did not see the need to adopt it in this late stage of their careers. Specifically, in Mizoram and Rajasthan teachers were vocal about expressing the need for a connect with the certificate programme and their career, and none of the teachers continued with the online learning beyond a cursory engagement.

2017-18 Community of Practice

The second source of data analysed led to a vast information bank. The data were analysed in two ways. Quantitative measures for the calendar year 2018 for all the communities that included number of members, number of posts and photos posted by faculty, teachers and by the days of the week were analysed. Specific posts of teachers that highlighted their engagement with the programme have been identified and collected throughout the implementation period and presented in the chapter. Teachers were made members of subject-based groups on Telegram during the workshops. In January 2018 the total number of teacher members across all the community of practice groups was 1900 (Figs. 11.3 and 11.4).

The teachers posted every day about their experiences and concerns about the workshop, and the activity was high. Once the workshop was completed the teacher posts were usually limited to inquiring about technical issues related to their school computer lab, sharing photos of students engaging with the CLIx student modules in their schools, while implementing the practice component of the courses. Many of the teachers were already a part of local district subject groups and from the beginning moderated the group posts accepting only education and subject related posts. During the workshops, there were about 40 to 60 posts a day that reduced to an average of 5 to 15 posts subsequently. "Friday Mathematics Education Time" post was posted every Friday in the Telangana Mathematics Group attempting to increase teacher participation in the community of practice. This post generated interest among teachers, and at least 4 to 5 teachers actively participated in the discussions. The Telangana mathematics teacher's community of practice group showed a 27 % increase in the total number of posts on Fridays as compared to the other weekdays in 2018. In the Chhattisgarh mathematics teacher's community of practice group, one teacher expressed appreciation for the Friday posts, saying, " Thank you so much for giving this interesting question. I know that you and your team work hard to post such questions that make us think. I

have enjoyed this post as much as the previous posts". Subsequently, Friday Times was initiated in all subject groups. Although some of the managed posts engaged with PCK-related content, teachers were responsive to problem solving and puzzles-based posts. For example, there were hardly any responses to questions asked about students' misconceptions, students thinking or ways of representing concepts to enable students to learn. The participation in the communities of practice by TISS faculty and CLIx team was only slightly less than the participation by teachers. Many of the posts initiated by teachers were photos they shared of implementing the CLIx modules or special events in their schools. Table 11.3 shows the distribution of the posts in the communities of practice by subjects.

The TISS faculty play an important role in moderating the discussions in the communities of practice. For example, in the dialogue that was facilitated in the Rajasthan English teacher's community of practice, one teacher wrote "One should not insist on accuracy before Fluency is gained. Two other teachers, who did not completely agree, responded, "Accuracy is required with fluency" and "Accuracy is also important for a child to get knowledge of grammar and vocabulary". When a TISS faculty probed "Some of you have said fluency first then accuracy. Some of you have said both accuracy and fluency are equally important. Can you explain why you think so ?", the responses from the first and second teachers were, "I think if we prefer accuracy students will hesitate to learn the language" and "Accuracy is more important rather than fluency. We all should focus on accuracy, fluency is gained gradually. Without accuracy we will communicate incorrectly". Such dialogues bring out the voices of the teachers, their reasoning and also enable the readers to engage more deeply with the aspects of accuracy and fluency for English language learning and pedagogy. The communities of practice have through these different forms of management by the faculty enabled the teachers to continue to share their implementation experiences establishing programme continuity and a link between university faculty and school teachers (Thirumalai, 2019).

2017-18 Practice-based pedagogy - Implementation in schools

The third dataset, the practice-based component of the course required teachers to implement at least one of the CLIx student modules of their subject in schools. Templates were provided to scaffold teacher's reflection and reporting processes (Setty, 2016). For example, the mathematics teacher course book (CLIx, 2018) has two sections Student Observation and Self-Reflection (See Fig.11.5) that enable teachers to inquire into their classroom learning and teaching. Teachers are required to record their experiences, student's learning and work and submit reports as course assignments. Teachers are also encouraged to share their experiences on the communities of practice to enable collaborative reflection among peers (Fig 11.6).

Teacher interviews and observations conducted during workshops and field visits showed that teachers mainly relied on their own experiences as students to develop their pedagogies.

Moreover, there was a significant reliance on the CLIx field team members to provide technical and infrastructure support, especially to just initiate the implementation process in schools. Many teachers believed that student-centred and constructivist pedagogies needed to be adopted, however during the computer lab sessions these teachers by and large adopted lecture-based methods of teaching. Furthermore, while the formative assessment methods are put in practice, but its tenets as reflected in teachers' beliefs about formative assessment and the lack of providing feedback for learning are missing. However, teachers, recognised and shared how the use of the CLIx student modules have generated significant subject-based peer discussion among students. For example, as all computer-based activities of the module are designed as group activities, several teachers have reported how students were discussing properties of quadrilaterals amongst themselves in order to succeed in the *PoliceQuad* game. There are also many examples of students collaborating to create a story while using the *Open Story Tool*. The field visits and discussions in the communities of practice revealed that teachers are not exposed to the idea of reflecting on their practice or using an inquiry approach to their teaching. Largely teachers assumed that students have learned when they had completed teaching a topic. Teachers therefore feel compelled to cover the syllabus and hence found the activities to be suited for lower grades and mismatched[7] for their 9th-grade class and express a lack of time to implement the CLIx module. Hence, the reflective reports and sharing of the practice-based component and the timetabling of the implementation of the CLIx modules have been the most challenging aspects to implement in the programme.

2017-18 TPD Review - Teacher Interviews

The fourth data set consisted of teacher interviews taken at the end of the course to consolidate the post course perspectives of select teachers provided insights at variance with some of the workshop data and in concordance with some of the other data sets. Having engaged with the course for over 12 weeks, the teachers' evaluation of the courses were nuanced. Many teachers spoke of the tool-based affordance such as the need for "more mobile-friendly features" on the course platform and the need for "more videos" to make the course "less text-heavy". They felt the courses were "too long" and were anxious about the "student-focused learning". Teachers completing the courses reported "improved teaching" as a result of the courses and appreciated the sustained engagement demanded by the programme and the continuous help given by the CLIx and RTICT teams.

DISCUSSION

This CPD programme introduced many new ideas through the RTICT. First, the use of ICT in the teaching-learning process and for professional development and second teachers were exposed to a reflective and practice-based model of professional development. These themes have been

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[7] The level of understanding of English, mathematics and science among a majority of the students does not match their grade level. The CLIx student modules have been designed to build conceptual understanding from the basics to the grade nine level.

discussed, explicating the highlights and challenges of how this CPD framework worked on the field to inform the next iteration of programme design and implementation.

Use of ICT in the teaching-learning process

The use of ICT in the teaching-learning process have been mostly in passive forms[8], where students are made to watch videos or presentations. Such ICT based resources make learning passive. The ICT resource development has been dominated[9] by private education technology companies and vendors. Both the certificate foundation course and the pedagogical courses have problematized the use of such resources in the lesson planning activities, making teachers aware of using technology when it matters as well as understanding the affordances of technologies to create an active and interactive learning experience for students. In the feedback at least 10% of the teachers in all the courses did not feel confident about making lesson plans integrating ICT, which is encouraging. Teachers have also changed their outlook towards using ICT as a replacement for classroom teaching to look at ICT as complimenting their regular teaching learning processes (Thirumalai, 2019; Ramanathan 2018). Teachers now see ICT use in a blended manner, adopting hands on activities, classroom discussions and field experiences along with ICT use to teach a topic. Teachers were surprised as well as enthusiastic that their professional development was not limited to workshops, and that 'someone' cared and followed up about how they were going to implement their learning in the classrooms. Many teachers have been continuously posting photos of implementing the student modules on the teacher communities of practice, see Table 11.3. Although teachers have not had a follow-up workshop in 2017-18 in Telangana, implementation continues in many schools and teachers share photographs of the processes (Ramanathan, 2018) (Fig 11.7) .

Use of ICT for Professional Development
The use of ICT for professional development is relatively newer for this cohort of teachers. Teachers have participated in subject-based online email-based forums and mobile messaging groups and in workshops for creating open educational resources. However teachers were participating for the first time in an online course using a practice-based pedagogy. Majority of the teachers engaged actively in the workshops but found it difficult to independently implement the student modules in their schools due to a lack of confidence in handling the school computer lab or because of poor infrastructure. The CLIx field team members needed to visit the schools to initiate the process in the majority of the schools. Although schools had been surveyed for

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[8] During field visits through the Digital Classroom Programme of the states , students were seen sitting in front of a television or projector screen and watching pre-recorded lessons by expert teachers of the state. Students looked disconnected and bored as there was minimal interaction. However, many of the teachers were excited about the programme.

[9] An internal study of education technology programmes conducted in 2015 to review the landscape of ed-tech programmes in India.

computer lab readiness at the beginning of the programme, many schools faced infrastructure issues at the time of actual implementation. The mobile-based community of practice was designed to enable teachers to engage in course level discussions as well as discussions around their experience of implementing. Although over 80% of the teachers were keen to participate and complete the course, very few teachers engaged in the online learning process. Initial field experiences indicated several reasons for this, including lack of time, no access to a laptop and importantly the lack of skills to engage in online learning. Teachers need to develop skills for online learning. Additionally, teachers working in rural schools typically have long commute times and hence long work days. For online learning to be active the teachers need to be provided time during their workday to participate. Self-reporting processes were used to assess the practice component of each course. However, the inability of teachers to describe their experiences in practice impacted our ability to gauge the effectiveness and quality of the experience. Initial field experiences indicate that self-reporting of the practice component of the course by teachers is not adequate as teachers also need to develop skills of reflection as well as update their professional knowledge, especially PCK. Teachers have recognised that the community of practice is a way of seeking academic support. Although teachers are still reluctant and shy to post on the group, many teachers have connected with specific faculty members seeking academic and pedagogic support. With teacher's permission the faculty usually repost their queries in the community of practice groups. The university-school linkages are established in this way as well (Fig. 11.8).

Systemic

At the macro level, we saw the implementation take shape differently in each state. At each level of implementation, there have been intense negotiations with the state, for example, regarding the number of days of workshops allotted for the programme, fixing the dates, venue and other logistical considerations. Although at a macro level the states have internalised the value of the CPD offering, at a micro level, teachers themselves did not perceive any benefits of the course programme certification as it did not have a direct impact on their career. The plan to build the capacity of teacher educators in all states did not materialise in three of the four states. There is an acute shortage of teacher educators in general (Batra, 2012) and in all states experienced teachers are taking on this role. Due to the low completion rate of the online courses in 2017-18, in 2018-19 the certificate programme has been offered only to a select number of teachers identified as teacher educators in each state, who have been recognised by the state education department as resource persons (teacher educators) in order to create a nested model of CPD to facilitate the workshops in each state , to enable scaling the blended mode of delivery. The identified resource persons participate in two communities of practice, the teacher educator community of practice as well as their subject teachers community of practice in each state. They are also required to take the 2-credit elective course *Mentoring for Teacher Professional Development* to complete their certificate programme. The teachers who have enrolled and not completed the courses in the 2017-

18 programme continue to participate in the communities of practice and implement the CLIx student modules in schools.

CPD Programme

This evaluation research has also helped in comparing the espoused framework with the actual implementation and has brought forth some issues and challenges in the design as well as implementation processes of the programme. The digital literacy levels and teacher's access to the internet made us realise, very early in the programme that teacher's required mobile-based technology. However, the schools presented a different context and required a student platform that would work on desktops. The differing accessibility to technology has led to teachers requiring three distinct technology platforms, a student module platform, a course platform and the mobile messaging application for the communities of practice. The use of multiple technology platforms created significant confusion, and many teachers were initially overwhelmed. How we can consolidate and connect the various platforms to streamline the technology experiences of teachers will be a design aspect to consider in future iterations. The extent of support and mentoring required to enable teachers in implementing the CLIx students module is enormous. A practice-based CPD is sustainable at scale only through robust implementation monitoring and teacher communities of practice. An entirely technology-based online community of practice will be insufficient to sustain the rigour and quality of a practice-based approach. The need to nurture local face-to-face meetups and complement it with the online community of practice activities will enable sustaining the quality of the programme at scale. Universities in India are only recently beginning to develop and offer online programmes. The changes to university structures and faculty pedagogies for online learning is evolving. This dual development needs of university faculty, as well as teachers, poses many challenges, particularly in the management of faculty time for running the courses, managing communities of practice and mentoring teachers. However, the implementation processes have now given us a more realistic picture of the structural changes and professional development requirements of university faculty as well.

THE WAY FORWARD

The NCF 2005 and the NCFTE 2009 have provided us with a strong foundation and frameworks to develop a reflective model of professional development to support teachers to transform their pedagogies to create active learning environments. These documents point us to the ideal goals of professional development. The implementation of the Reflective Teaching with ICT teacher certificate programme at scale has enabled us to understand better the processes that are required to achieve these goals, and we have moved a few steps forward in this direction with many more steps to go. By and large educational academicians are not taken seriously by policy makers because of the disconnect from the actual field action and therefore discussions of CPD in the

universities become largely academic exercises (Setty, 2016, Sarangapani, 2011, 2004). The fact that only about 2% of the teachers completed the online programme is actually a minor concern as online learning is new and as the baseline studies (Chandran & Roy, 2017) indicate over 50% of teachers need to become digitally literate. The experiences and understanding of the processes gained have been enormous. We now have a cohort of experienced teachers in two state successfully completing the courses and playing the role of teacher educators and mentoring their peer; many teachers continue to implement the CLIx student modules in their school computer labs and classrooms, sharing their experiences in the online community of practice.We have successfully established links between schools, the university and the state education departments through the online communities of practice and field level programme support. These links have already provided us with the processes for supporting academic and pedagogic work.

A CPD framework cannot be a static artefact, as it changes with every iteration of implementation by integrating the complexities of the field and requires constant negotiation with the state education departments. Our positions in the negotiation processes have strengthened. While we submitted to most implementation design changes asked by the states in the previous two years, we now have evidence from the field to justify some of the critical design aspects. For example, to offer the *Reflective Teaching with ICT* certificate programme only when states have provided adequate ICT infrastructure in schools and creating strategies for ongoing academic and pedagogic support, both through peer mentoring and managing posts through the community of practice. The importance of situating the approaches for implementing the framework within systemic structures and policies cannot be overemphasised.

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TABLES & FIGURES

Table 11.1: CLIx Teacher Professional Development Approach

Design	Approach	Mechanisms
Pedagogical Courses + Foundation Course: ICT in Education including Digital Literacy	A 17-credit, two-year postgraduate certificate programme, Reflective Teaching with ICT (PGC RTICT) offered by TISS in the blended mode in multiple Indian languages.	TISSx - *Open Edx* platform for delivery of courses MitiBot – a *Telegram* bot to access course resources via the smartphone
Community of Practice	An online community of practice	Open source mobile messaging application - *Telegram*
Practice-Based Learning	Implementing the exemplar CLIx student modules - English, mathematics and science Open Educational Resources developed for students by CLIx Reflecting & reporting on experiences of implementing the modules	CLIx Platform is a next generational digital learning environment designed for connected and collaborative learning at K-12 Reporting templates and teacher coursebooks - formal Sharing on the communities of practice - informal Monitoring and technical support through periodic field visits by CLIx field team members
Pedagogic Pillars	All student and teacher resources exemplify the pillars as relevant in design. Workshops adopt the pillars in the facilitation process	Pedagogy framework of CLIx

Table 11.2: CLIx Teacher Professional Development - Workshop Implementation 2016 to 2018

2016-17 Workshops for CLIx Student Module Implementation				2017-18 Workshops for Reflective Teaching with ICT teacher certification programme Courses			
Teachers (Invited) Participated				**Teachers (Invited) Participated**			
State	**Digital Literacy**	**English**	**Math**	**Science**	**C01 (ICT & Education)**	**S01 (English)**	**S02 (Math)**	**S03 (Science)**
CG	(103) 93	(34) 29	(33) 28	n/a	(103) 72	(33) 29	(33) 29	(36) 24
MZ	(165) 164	(58) 36	(53) 34	(54) 30	(167) 164	(58) 22	(52) 26	(57) 27
RJ	(264) 248	88 (50)	(84) 46	n/a	(313) 224	103 (58)	(102) 55	(104) 71
TS	60 Teacher Educators	230	n/a	n/a	(1807) 1472	(481) 375	(547) 471	(978) 743

Note: In Table 11.2 the first header row "State | Digital Literacy | English | Math | Science" corresponds to the 2016-17 columns and "C01 | S01 | S02 | S03" to the 2017-18 columns.

Table 11.3: Teacher Communities of Practice - Percentage of total posts in four states for 2018

Communities of Practice [4 states]	Number of Posts	Posts by TISS Faculty and other CLIx Team members	Posts by Teacher [Text based]	Posts by teachers [Photos of implementation shared]
English	2760	42.54%	35.83%	17.21%
Mathematics	3901	41.09%	37.58%	21.33%
Science	4872	44.99%	31.67%	24.08%

Fig. 11.1 Reflective Teaching with ICT (RTICT) professional development platform Implementation
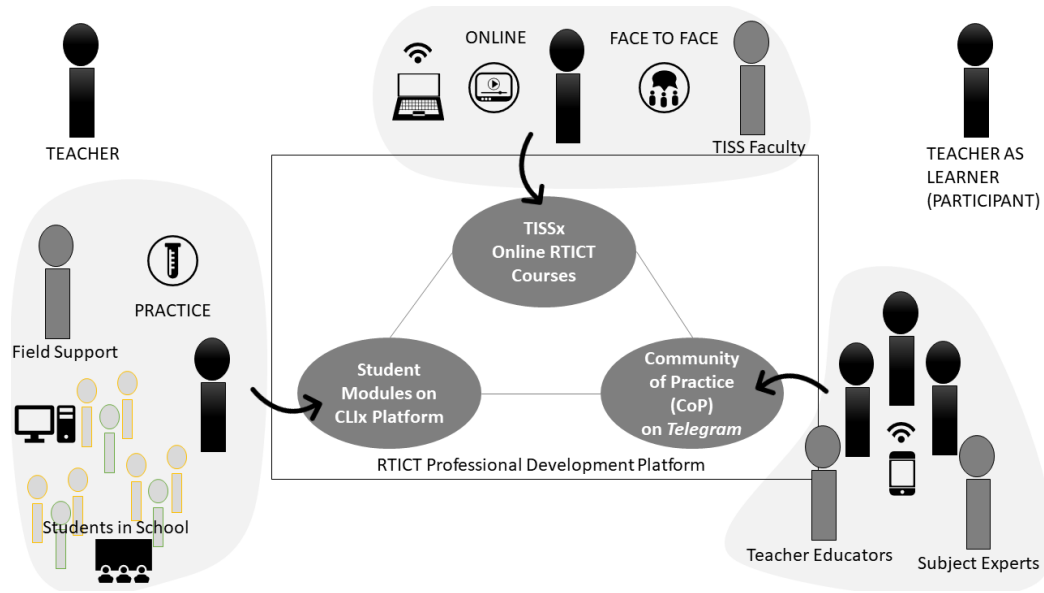

Fig. 11.2
Teacher's voices 1—English teacher Mizoram, workshop feedback, teacher's community of practice

I really find CLIx student modules useful because it is very intreactive and requires active participation of the kids at individual, pair and group levels. Yesterday's class was an eyeopener for us, showing that English class can be real fun and funny at times.

- English Teacher Mizoram, Workshop feedback, Teacher's Community of Practice

Fig. 11.3
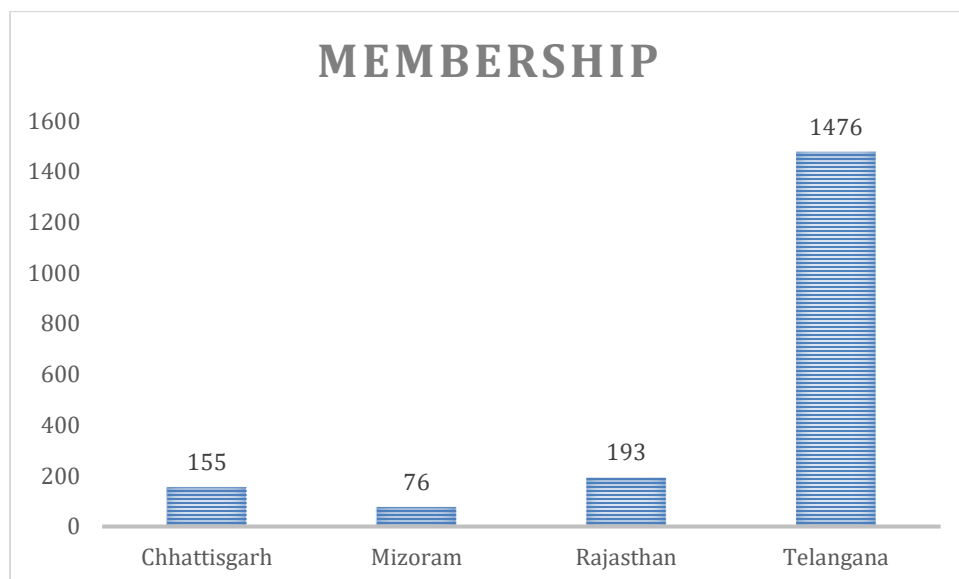**Teacher membership online communities of practice by state (January 2018)**

MEMBERSHIP

Chhattisgarh 155, Mizoram 76, Rajasthan 193, Telangana 1476

Fig. 11.4
Teacher membership online communities of practice by school subject (January 2018)

TEACHER MEMBERSHIP ONLINE COMMUNITIES OF PRACTICE BY SCHOOL SUBJECT (JANUARY 2018)
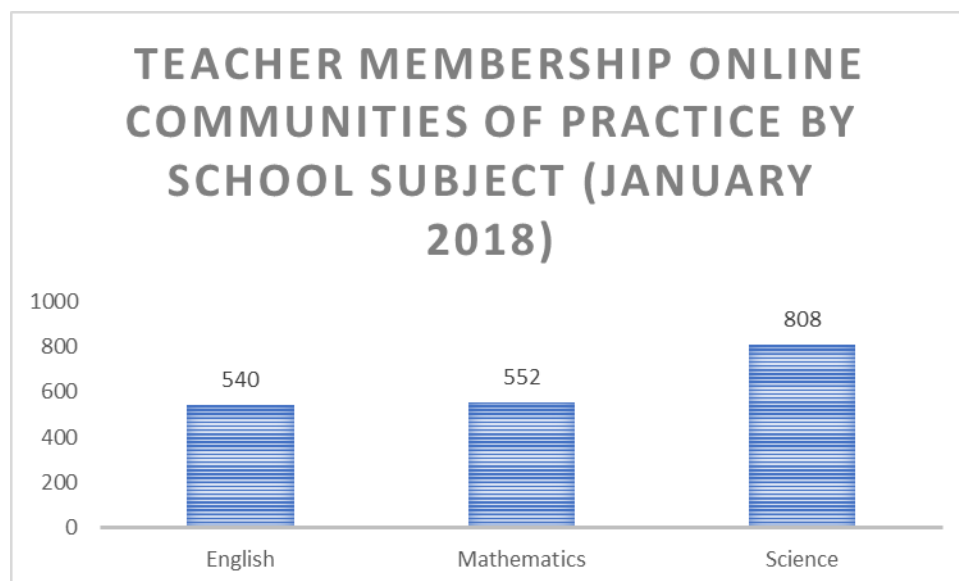
English 540, Mathematics 552, Science 808

Fig. 11.5
My notes: mathematics teachers course book

My Notes

Student Observations	
How did students discuss the game in the class? Give some examples.	
What are the different criteria that students came up with while doing the sorting activity? Note down atleast 4.	
What are some of properties that students understood? Note down at least 3.	
What were the common mistakes observed by you? How did you address them?	

Self-Reflection	
In the group activity,did the students discuss the given task? Note down some discussions.	
Was it easy for you to organize the group activity? Note down some of the challenges that you faced.	
How were you able to use students' experience of playing the game in the classroom discussion?	

Fig. 11.6
Teacher's voices 2—mathematics teacher Chhattisgarh, teacher's community of practice, implementing the geometric reasoning—Part I CLIx student module

Today I divided students of 9th in 3 groups of each 18 members and discussed properties of quadrilaterals and connection among the shapes. First group worked in the computer lab on the CLIx student modules to understand properties and shape relationships. Second group worked on Tangram and Geoboard and tried making shapes. Third group worked with paper pencil, tried to make shapes with paper cutting. All students were busy and enjoyed working. Making shapes with Tangram was most challenging. Finally, they could not make a trapezium or rhombus. They will try again tomorrow.

- Mathematics Teacher Chhattisgarh, Teacher's Community of Practice, Implementing the Geometric Reasoning – Part I CLIx student module

Fig. 11.7
Teachers voices 3—science teacher Telangana, teacher's community of practice, implementing CLIx student module

Teacher: Today's field visit for the Ecosystem CLIx student Module. [Photo Attached]

TISS Faculty: Wow! Seems like everyone had fun :) It is so great to be outdoors :) Did students like it?

Teacher: Yes Madam, they liked it very much. After coming back, we had a session in our projector room and studied the CLIx Ecosystem module.
    -Science Teacher Telangana, Teacher's Community of Practice, Implementing CLIx student module

Fig. 11.8
Teachers voices 4—mathematics teacher Telangana, interview

I think the posts on the community of practice are very useful. I try to solve all the problems posted on Fridays and I am compiling the problems and the solutions in my notebook as a reference.
-        Mathematics Teacher Telangana, Interview